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FINAL SUMMARY REPORT

GRANT AFOSR 62-250

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11 February 1963

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A. Introduction

This report summarizes the research accomplished during the period 1 February, 1962 to 1 February, 1963 under Grant AFOSR 62-250. Included are listings of papers presented or published, and personnel who have worked on the project.

B. Technical Progress

1. Microwave Modulation of Light

Work was continued on the study of the microwave and electrooptical properties of liquids exhibiting the Kerr effect. The most important finding was that the dielectric losses of Carbon Disulfide at microwave frequencies are exceptionally low; loss tangents less than 10^{-4} at 3 Gc were measured. This data prompted the design and testing of a Carbon Disulfide Kerr cell of the travelling wave type. Microwave modulation of light was achieved with a few hundred watts microwave power. It was subsequently determined that a reduction in temperature increased the Kerr constant significantly as well as increasing the dielectric strength of Carbon Disulfide. This information is expected to lead to further reductions in required microwave power for light modulation.

2. Detection of Microwave-Modulated Light

The study of dynamic crossed-field electron multiplication was continued. Photo-multipliers incorporating this method were fabricated and tested. Successful direct detection of microwave modulated light was achieved with gains as high as 100 db. Earlier difficulties with a multipactoring effect were circumvented by a design change. It appears that this device is the only microwave bandwidth photo-detector capable of direct detection of low level light signals ($<10^{-7}$w) with useful power output ($>10^{-7}$w).

3. Optical Masers

Studies and experiments with optical masers were carried out to develop laboratory tools best suited for use in the modulation and detection research. The internally reflecting confocal optical resonator was reduced to practice; a neodymium in glass laser rod (fabricated by Dr. Paul Keck of Texas Instruments, Inc.) having the desired configuration was tested. Stimulated emission was achieved at relatively low thresholds.

C. Publications

1. O. L. Gaddy and D. F. Holshouser, "High Gain Dynamic Microwave Photomultiplier", Proc. IRE, Vol. 50, No. 2. February 1962.
2. O. L. Gaddy and D. F. Holshouser, "Photomultiplier Detection with Microwave Response", Proc. IRE, Vol. 50, No. 6, June 1962.
3. O. L. Gaddy and D. F. Holshouser, "A Microwave Frequency Dynamic Crossed-Field Photomultiplier", Proc. IRE, Vol. 51, No. 1, January 1963.
4. O. L. Gaddy, Doctoral thesis, June 1962.
5. D. F. Holshouser, "Internally Reflecting Optical Resonator with Confocal Properties", Proc. of Third International Quantum Electronics.
6. O. L. Gaddy and D. F. Holshouser, "Photomultiplication with Microwave Response", Proc. of Third International Quantum Electronics Conference (to be published).
7. O. L. Gaddy, D. F. Holshouser, and R. Stanfield, "Microwave and Electrooptical Properties of Carbon Disulfide", Proc. of Third International Quantum Electronics Conference (to be published).

In addition to these publications unpublished papers were presented at the Electron Device Research Conference, National Electronics Conference, IRE Chicago Section Meeting, and the M.I.T. summer course on Optical Masers.

D. Personnel

The following technical personnel worked on the project:

Don F. Holshouser, Associate Professor and Chief Investigator
Oscar L. Gaddy, Graducate Assistant and Assistant Professor
Robert Stanfield, Graduate Assistant

Professor Gaddy Received his doctorate during this period and Mr. Stanfield achieved his master's degree.